

The following listing of claims replaces all prior versions and listings of claims in this application.

Listing of Claims

1. (Currently Amended) A method of detecting a change in a vascular condition, comprising:
 - receiving sound information associated with blood flowing through a vascular structure;
 - converting the sound information into data associated with a plurality of cardiac cycles;
 - processing the data associated with the plurality of cardiac cycles to determine ~~an acoustic characteristic associated with a current state of the vascular condition~~ a spectral characteristic for each of a plurality of frequencies within a frequency band for a first group of the cardiac cycles associated with a current state of the vascular condition and a second group of the cardiac cycles associated with an earlier state of the vascular condition; and
 - detecting the change in the vascular condition based on a ~~difference~~ comparison between the acoustic characteristic associated with the current state of the vascular condition and an acoustic characteristic associated with ~~an~~ the earlier state of the vascular condition, wherein the comparison comprises calculating a difference between each of the spectral characteristics at each of the frequencies for the first group of the cardiac cycles and the spectral characteristic at the corresponding frequency for the second group of the cardiac cycles.
2. (Currently Amended) A method as defined in claim 1, wherein detecting the change in the vascular condition ~~based on the difference between the acoustic characteristic~~

~~associated with the current state of the vascular condition and the acoustic characteristic associated with the earlier state of the vascular condition~~ includes detecting a change in an amount of stenosis associated with the vascular structure.

3. (Currently Amended) A method as defined in claim 1, wherein detecting the change in the vascular condition includes ~~using the difference between the acoustic characteristic associated with the current state of the vascular condition and the acoustic characteristic associated with the earlier state of the vascular condition to calculate~~ calculating a parameter associated with a change in a diameter associated with the vascular structure.

4. (Original) A method as defined in claim 3, wherein detecting the change in the vascular condition includes comparing the parameter associated with the change in the diameter to a threshold value associated with a significant change in the vascular structure.

5. (Currently Amended) A method as defined in claim 1, wherein ~~detecting the change in the vascular condition based on the difference between the acoustic characteristic associated with the current state of the vascular structure and the acoustic characteristic associated with the earlier state of the vascular condition~~ includes ~~calculating a difference between first spectral data associated with the acoustic characteristic associated with the earlier state of the vascular condition and second spectral data associated with the acoustic characteristic associated with the current state of the vascular condition~~ processing the data comprises processing data representing only non-repeatable portions of each of the cardiac cycles.

6. (Currently Amended) A method as defined in claim ~~[[5]]1~~, wherein the ~~first and second spectral data include at least one of average spectral data and dominant frequency~~ data spectral characteristic comprises an average energy or a dominant frequency.

7. (Currently Amended) A method as defined in claim ~~[[5]]1~~, wherein ~~calculating the difference between the first spectral data associated with the acoustic characteristic associated with the earlier state of the vascular condition and the second spectral data associated with the acoustic characteristic associated with the current state of the vascular condition includes the comparison~~ comprises calculating at least one of a true root mean square, a root mean square, ~~and~~ or a mean of the ~~difference between the first and second spectral data~~ differences between each of the spectral characteristics.

8. (Currently Amended) A method as defined in claim 1, wherein detecting the change in the vascular condition ~~based on the difference between the acoustic characteristic associated with the current state of the vascular structure and the acoustic characteristic associated with the earlier state of the vascular condition~~ includes further comprises calculating a difference between first temporal data associated with the acoustic characteristic associated with the earlier state of the vascular condition and second temporal data associated with the acoustic characteristic associated with the current state of the vascular condition.

9. (Currently Amended) A method as defined in claim 8, wherein calculating the difference between the first ~~spectral~~ spectral temporal data associated with the acoustic characteristic associated with the earlier state of the vascular condition and the second ~~spectral~~ spectral temporal data associated with the acoustic characteristic associated with the current state of the

vascular condition includes calculating at least one of a true root mean square, a root mean square, ~~and~~or a mean of the difference between the first and second temporal data.

10. (Original) A method as defined in claim 8, wherein the first and second temporal data include signal envelope data.

11. (Original) A method as defined in claim 1, wherein receiving the sound information associated with the blood flowing through the vascular structure includes receiving the sound information via a plurality of acoustic sensors proximate to the vascular structure.

12. (Original) A method as defined in claim 1, wherein converting the sound information into the data associated with the plurality of cardiac cycles includes using signal envelope template data to temporally align the data associated with the plurality of cardiac cycles.

13. (Currently Amended) A method as defined in claim 12, wherein using the signal envelope template data to temporally align the data associated with the plurality of cardiac cycles includes identifying each of the cardiac cycles using at least one of maxima information ~~and~~or cross correlation information.

14. (Original) A method as defined in claim 12, wherein using the signal envelope template data to temporally align the data associated with the plurality of cardiac cycles includes calculating a difference between the data associated with each of the cardiac cycles and the template data.

15. (Currently Amended) A method as defined in claim 1, wherein processing the data ~~associated with the plurality of cardiac cycles to determine the acoustic characteristic associated with the current state of the vascular condition~~ includes comprises selecting a band of frequencies that increases a correlation between the acoustic characteristic and the vascular condition.

16. (Original) A method as defined in 15, wherein selecting the band of frequencies that increases the correlation between the acoustic characteristic and the vascular condition includes automatically optimizing the band of frequencies.

17. (Currently Amended) A system for detecting a change in a vascular condition, comprising:

a memory; and

a processor coupled to the memory and programmed to:

receive sound information associated with blood flowing through a vascular structure;

convert the sound information into data associated with a plurality of cardiac cycles;

process the data associated with the plurality of cardiac cycles to determine ~~an acoustic characteristic associated with a current state of the vascular condition~~ a spectral characteristic for each of a plurality of frequencies within a frequency band for a first group of the cardiac cycles associated with a current state of the vascular condition and a second group of the cardiac cycles associated with an earlier state of the vascular condition; and

detect the change in the vascular condition based on a ~~difference comparison~~ between the acoustic characteristic associated with the current state of the vascular condition

and an acoustic characteristic associated with ~~an~~the earlier state of the vascular condition,
wherein the comparison comprises calculating a difference between each of the spectral
characteristics at each of the frequencies for the first group of the cardiac cycles and the
spectral characteristic at the corresponding frequency for the second group of the cardiac
cycles.

18. (Currently Amended) A system as defined in claim 17, wherein the processor is programmed to detect the change in the vascular condition ~~based on the difference between the acoustic characteristic associated with the current state of the vascular condition and the acoustic characteristic associated with the earlier state of the vascular condition~~ by detecting a change in an amount of stenosis associated with the vascular structure.

19. (Currently Amended) A system as defined in claim 17, wherein the processor is programmed to detect the change in the vascular condition ~~using the difference between the acoustic characteristic associated with the current state of the vascular condition and the acoustic characteristic associated with the earlier state of the vascular condition to calculate~~ by calculating a parameter associated with a change in a diameter associated with the vascular structure.

20. (Original) A system as defined in claim 19, wherein the processor is programmed to detect the change in the vascular condition by comparing the parameter associated with the change in the diameter to a threshold value associated with a significant change in the vascular structure.

21. (Currently Amended) A system as defined in claim 17, wherein the processor is programmed to ~~detect the change in the vascular condition based on the difference between~~

~~the acoustic characteristic associated with the current state of the vascular structure and the acoustic characteristic associated with the earlier state of the vascular condition by calculating a difference between first spectral data associated with the acoustic characteristic associated with the earlier state of the vascular condition and second spectral data associated with the acoustic characteristic associated with the current state of the vascular condition~~
process the data by processing data representing only non-repeatable portions of each of the cardiac cycles.

22. (Currently Amended) A system as defined in claim ~~[[21]]~~17, wherein the ~~first and second spectral data include at least one of average spectral data and dominant frequency data~~
spectral characteristic comprises an average energy or a dominant frequency.

23. (Currently Amended) A system as defined in claim ~~[[21]]~~17, wherein the ~~processor is programmed to calculate the difference between the first spectral data associated with the acoustic characteristic associated with the earlier state of the vascular condition and the second spectral data associated with the acoustic characteristic associated with the current state of the vascular condition by~~
comparison comprises calculating at least one of a true root mean square, a root mean square, and~~or~~a mean of the difference between the first and second spectral data
differences between each of the spectral characteristics.

24. (Currently Amended) A system as defined in claim 17, wherein the processor is programmed to detect the change in the vascular condition ~~based on the difference between the acoustic characteristic associated with the current state of the vascular structure and the acoustic characteristic associated with the earlier state of the vascular condition by~~
calculating a difference between first temporal data associated with the acoustic characteristic

associated with the earlier state of the vascular condition and second temporal data associated with the acoustic characteristic associated with the current state of the vascular condition.

25. (Currently Amended) A system as defined in claim 24, wherein the processor is programmed to calculate the difference between the first ~~spectral~~temporal data associated with the acoustic characteristic associated with the earlier state of the vascular condition and the second ~~spectral~~temporal data associated with the acoustic characteristic associated with the current state of the vascular condition by calculating at least one of a true root mean square, a root mean square, ~~and/or~~ a mean of the difference between the first and second temporal data.

26. (Original) A system as defined in claim 24, wherein the first and second temporal data include signal envelope data.

27. (Original) A system as defined in claim 17, wherein the processor is programmed to receive the sound information associated with the blood flowing through the vascular structure via a plurality of acoustic sensors proximate to the vascular structure.

28. (Original) A system as defined in claim 17, wherein the processor is programmed to convert the sound information into the data associated with the plurality of cardiac cycles using signal envelope template data to temporally align the data associated with the plurality of cardiac cycles.

29. (Currently Amended) A system as defined in claim 28, wherein the processor is programmed to use the signal envelope template data to temporally align the data associated with the plurality of cardiac cycles by identifying each of the cardiac cycles using at least one of maxima information ~~and/or~~ cross correlation information.

30. (Original) A system as defined in claim 28, wherein the processor is programmed to use the signal envelope template data to temporally align the data associated with the plurality of cardiac cycles by calculating a difference between the data associated with each of the cardiac cycles and the template data.

31. (Currently Amended) A system as defined in claim 17, wherein the processor is programmed to process the data associated with the plurality of cardiac cycles to determine the acoustic characteristic associated with the current state of the vascular condition by selecting a band of frequencies that increases a correlation between the acoustic characteristic and the vascular condition.

32. (Original) A method as defined in 31, wherein the processor is programmed to select the band of frequencies that increases the correlation between the acoustic characteristic and the vascular condition includes by automatically optimizing the band of frequencies.

33. (Currently Amended) A machine readable medium having instructions stored thereon that, when executed, cause a machine to:

receive sound information associated with blood flowing through a vascular structure;
convert the sound information into data associated with a plurality of cardiac cycles;
process the data associated with the plurality of cardiac cycles to determine an acoustic characteristic associated with a current state of a vascular condition a spectral characteristic for each of a plurality of frequencies within a frequency band for a first group of the cardiac cycles associated with a current state of the vascular condition and a second group of the cardiac cycles associated with an earlier state of the vascular condition; and

detect a change in the vascular condition based on a ~~difference~~comparison between the acoustic characteristic associated with the current state of the vascular condition and an acoustic characteristic associated with ~~an~~the earlier state of the vascular condition, wherein the comparison comprises calculating a difference between each of the spectral characteristics at each of the frequencies for the first group of the cardiac cycles and the spectral characteristic at the corresponding frequency for the second group of the cardiac cycles.

34. (Currently Amended) A machine readable medium as defined in claim 33 having instructions stored thereon that, when executed, cause the machine to detect the change in the vascular condition ~~based on the difference between the acoustic characteristic associated with the current state of the vascular condition and the acoustic characteristic associated with the earlier state of the vascular condition~~ by detecting a change in an amount of stenosis associated with the vascular structure.

35. (Currently Amended) A machine readable medium as defined in claim 33 having instructions stored thereon that, when executed, cause the machine to detect the change in the vascular condition ~~using the difference between the acoustic characteristic associated with the current state of the vascular condition and the acoustic characteristic associated with the earlier state of the vascular condition to calculate~~ by calculating a parameter associated with a change in a diameter associated with the vascular structure.

36. (Original) A machine readable medium as defined in claim 35 having instructions stored thereon that, when executed, cause the machine to detect the change in the vascular condition by comparing the parameter associated with the change in the diameter to a threshold value associated with a significant change in the vascular structure.

37. (Currently Amended) A machine readable medium as defined in claim 33 having instructions stored thereon that, when executed, cause the machine to ~~detect the change in the vascular condition based on the difference between the acoustic characteristic associated with the current state of the vascular structure and the acoustic characteristic associated with the earlier state of the vascular condition by calculating a difference between first spectral data associated with the acoustic characteristic associated with the earlier state of the vascular condition and second spectral data associated with the acoustic characteristic associated with the current state of the vascular condition~~process the data by processing data representing only non-repeatable portions of each of the cardiac cycles.

38. (Currently Amended) A machine readable medium as defined in claim ~~[[37]]~~33, wherein the ~~first and second spectral data include at least one of average spectral data and dominant frequency data~~spectral characteristic comprises an average energy or a dominant frequency.

39. (Currently Amended) A machine readable medium as defined in claim ~~[[37]]~~33 having instructions stored thereon that, when executed, cause the machine to ~~calculate the difference between the first spectral data associated with the acoustic characteristic associated with the earlier state of the vascular condition and the second spectral data associated with the acoustic characteristic associated with the current state of the vascular condition by~~wherein the comparison comprises calculating at least one of a true root mean square, a root mean square, and~~or a mean of the difference between the first and second spectral data~~differences between each of the spectral characteristics.

40. (Currently Amended) A machine readable medium as defined in claim 33 having instructions stored thereon that, when executed, cause the machine to detect the change in the vascular condition ~~based on the difference between the acoustic characteristic associated with the current state of the vascular structure and the acoustic characteristic associated with the earlier state of the vascular condition by calculating~~ by calculating a difference between first temporal data associated with the acoustic characteristic associated with the earlier state of the vascular condition and second temporal data associated with the acoustic characteristic associated with the current state of the vascular condition.

41. (Currently Amended) A machine readable medium as defined in claim 40 having instructions stored thereon that, when executed, cause the machine to calculate the difference between the first ~~spectra~~temporal data associated with the acoustic characteristic associated with the earlier state of the vascular condition and the second ~~spectra~~temporal data associated with the acoustic characteristic associated with the current state of the vascular condition by calculating at least one of a true root mean square, a root mean square, ~~and/or~~ a mean of the difference between the first and second temporal data.

42. (Original) A machine readable medium as defined in claim 40, wherein the first and second temporal data include signal envelope data.

43. (Original) A machine readable medium as defined in claim 33 having instructions stored thereon that, when executed, cause the machine to receive the sound information associated with the blood flowing through the vascular structure includes receiving the sound information via a plurality of acoustic sensors proximate to the vascular structure.

44. (Original) A machine readable medium as defined in claim 33 having instructions stored thereon that, when executed, cause the machine to convert the sound information into the data associated with the plurality of cardiac cycles using signal envelope template data to temporally align the data associated with the plurality of cardiac cycles.

45. (Currently Amended) A machine readable medium as defined in claim 44 having instructions stored thereon that, when executed, cause the machine to use the signal envelope template data to temporally align the data associated with the plurality of cardiac cycles by identifying each of the cardiac cycles using at least one of maxima information ~~and~~or cross correlation information.

46. (Original) A machine readable medium as defined in claim 44 having instructions stored thereon that, when executed, cause the machine to use the signal envelope template data to temporally align the data associated with the plurality of cardiac cycles by calculating a difference between the data associated with each of the cardiac cycles and the template data.

47. (Currently Amended) A machine readable medium as defined in claim 33, wherein the instructions, when executed, cause the machine to process the data ~~associated with the plurality of cardiac cycles to determine the acoustic characteristic associated with the current state of the vascular condition~~ by selecting a band of frequencies that increases a correlation between the acoustic characteristic and the vascular condition.

48. (Original) A machine readable medium as defined in 47, wherein the instructions, when executed, cause the machine to select the band of frequencies that increase

the correlation between the acoustic characteristic and the vascular condition by
automatically optimizing the band of frequencies.

Claims 49-81. (Cancelled)